1.0 Introduction

The Hawaii Windpower Workshop, held in Honolulu, Hawaii on March 21 to 22, 1994, was sponsored by the U.S. Department of Energy (DOE) and the State of Hawaii Department of Business, Economic Development and Tourism (DBEDT). The Pacific International Center for High Technology Research (PICHTR) organized and conducted the workshop in cooperation with U.S. DOE, the National Renewable Energy Laboratory (NREL), DBEDT and the Hawaiian Electric Company (HECO). About 80 key members from local and federal governments, the Hawaiian utilities, the wind industry, environmental and local community-action groups and the public attended the workshop. See appendix A for the list of participants.

There are two overall goals for this workshop:

- to support the integration of additional wind power into the Hawaiian utilities supply mix by providing up-to-date information and transfer of modern wind technology to the various stakeholders in Hawaii's energy arena, and
- to identify appropriate mechanisms for consideration of windpower within the IRP process.

The workshop was organized into a series of five sessions with a total of ten, one-hour panel discussions. See appendix B for the workshop agenda. Each of the panel discussions included a 3-minute presentation, followed by three, 5-minute panel member responses (panel 1 had 5 members), and a 15-minute general question and answer period. Each of the sessions and panel discussions are summarized in these proceedings as shown in the Table 1.1.

See appendices C through F for copies of the presentation charts/slides, and detailed notes on the panel member responses, and the general questions and answers.

Section	Session	Panel	Topic
1.2	1		History of Windpower in Hawaii
2	2		Technology and Resource Status
2.1	2	1	Technology and Industry
2.2	2	2	Resource Availability
2.3	2	3	Utility Interface Issues
3.0	3		Project Development and Implementation Issues
3.1	3	4	Project Development
3.2	3	5	Government Support
3.3	3	6	Benefits of Windpower to Hawaii
3.4	3	7	Integrated Resource Planning
4.0	4		Stakeholder Perspectives
4.1	4		Introductory Comments
4.2	4	8	Public Perspectives
4.3	4	9	Regulatory Perspectives
4.4	4	10	Legislative Perspectives
5.0	5		Wrap-Up, Conclusions and Recommendations

Table 1.1 Organization of the Proceedings

1.1 Opening Comments

Andrew Trenka, PICHTR vice president for engineering systems, started the Hawaii Windpower Workshop off by welcoming the participants on behalf of the sponsoring agencies, the U.S. DOE and the State of Hawaii DBEDT and acknowledged the contributions made by HECO and the Hawaii Natural Energy Institute of the University of Hawaii and NREL in the organization and coordination of the workshop. He expressed appreciation for the sponsors support and their interest in the topical areas of wind energy. He also extended his appreciation for the participants in sharing their perspectives on Hawaii's energy needs specifically wind power. Naming the various types of groups and organizations present, Mr. Trenka pointed out that the integration of all these groups is essential to putting together a viable plan for the implementation of wind energy in Hawaii:

- wind industry
- government agencies, both state and federal
- state legislators
- regulators
- utilities
- general public (including advocacy and consumer organizations)

He then went on to paraphrase the objectives of the workshop[1]:

1) Examine the viability of stimulating the integration of windpower into the Hawaiian energy mix.

2) Discuss the advances of wind technology while touching on the success stories and innovative approaches to the implementation of windpower on the mainland as well as worldwide.

3) Identify the appropriate and needed action for integrating windpower into the Hawaiian utilities via the integrated resource planning (IRP) process and other relevant innovative approaches. He pointed out that one of the reasons why PICHTR strove so mightily to hold the Windpower Workshop in March was because IRP planning activities were in process at that time and it was hoped that the deliberation from the workshop would help to impact that planning process. He emphasized that the IRP dockets and activities are critical for defining a pathway for the success of windpower in Hawaii.

[1] Editorial comment: It is believed that this approach could be applied readily to workshops for other renewable technologies.

Mr. Trenka cautioned the workshop participants to focus on the lessons learned from the past uses of windpower in Hawaii and not to lay blame on any one group for its failures. He also reminded them that the workshop was not a marketing tool for wind manufacturers but rather an opportunity to provide current information on the advances in the technology.

The primary objective of the workshop, he said, was to stimulate a dialog to assess the success stories of windpower on the mainland and discuss how it can be implemented here in Hawaii.

In closing, Mr. Trenka asked every participant present to introduce themselves and identify the organizations that they represented. Taking time to invite the sponsoring agencies to share some of their thoughts on wind energy, he first introduced Mr. Ron Loose, director of the Wind\Hydro\Ocean Division of the Office of Utility Technologies of the assistant U.S. secretary from the Department of Energy Efficiency and Renewable Energy. In this capacity, Mr. Loose also serves as the director of the U.S. Department of Energy's Federal Wind Energy Program.

Ronald Loose, U.S. DOE

Mr. Loose greeted the audience and, as director of the Federal Wind Energy Program, acknowledged the support from the Office of Integrated Resource Planning (administered by Dr. Robert San Martin) under the U.S. DOE Office of Utilities Technologies as cosponsors of the Hawaii Windpower Workshop.

We are witnessing some exciting times and perhaps seeing a resurgence from the 1980's in wind energy development, Mr. Loose noted. There have been substantial improvements and a dramatic increase in the federal wind energy budget. He pointed out that when he took office, the federal wind energy budget was about $8.5M. Going into the appropriation budget process for 1995, the budget is at $51.5M.

Currently the U.S. DOE supports seven different turbine designs being developed for near term use. There are working prototypes for these designs currently being tested. All of these should be on the market during 1994-1995 and the DOE has played an active role in their development, he emphasized.

In addition, the department has instituted a unique 1.5¢ production incentive which is quite different from past tax incentives. It works quite simply, he said, if you don't produce, you don't get paid!

"We are also witnessing an increase use of the integrated resource planning process by utility planners along with expanding markets both domestically and internationally for wind energy. Currently, 2000 MW are being negotiated or are in use. The American Wind Energy Association announced a goal of 10,000 MW by the year A.D. 2000. This is an ambitious but achievable goal," Mr. Loose stated. Coinciding with this, the European Union announced its goal of 4,000 MW by the year A.D. 2,000.

"We are seeing an emerging market that will provide business stability as the technology matures," Mr. Loose said.

More importantly from his perspective, he said, the administration's recent announcement of a *Global Climate Change Action Plan* has allowed the federal programs to reestablish support to a commercialization effort.

The action plan calls for a market mobilization collaborative. Industry, utilities and other interested stakeholders are in the process of forming that collaborative. These are just some of the things that are coming together to bring a very bright future for wind energy.

In closing, Mr. Loose stated that given Hawaii's wind resources, he was confident wind power can make a contribution to Hawaii's energy mix. He thanked everyone for their participation and looked forward to a productive workshop.

Tak Yoshihara, State of Hawaii DBEDT

Next, Mr. Trenka introduced Dr. Tak Yoshihara, deputy director of the State of Hawaii DBEDT.

Dr. Yoshihara began by welcoming participants on behalf of DBEDT as a cosponsor of the Hawaii Windpower Workshop. The primary responsibility of the Department of Business, Economic Development and Tourism, he pointed out, is to formulate policy and programs to stimulate support and promote economic development.

Hawaii's economy has been suffering for three years, due in large measure to the downturns in tourism attributable to the economies nationally and internationally. A major barrier to Hawaii's economic growth is the high cost of living and doing business.

"Energy is but one component of that cost but one we feel is very important. Hawaii's cost for electricity is the highest in the nation, three times higher than parts of the Northwest. Gasoline in Hawaii is currently priced at $1.50 a gallon. In Washington D.C., I am told today, a gallon of regular unleaded gasoline costs about $1.00," Dr. Yoshihara said.

"If we are to compete economically, we must reduce the cost of energy!" he stated. Because of the strong link between the economy and energy, the director of DBEDT has also been designated as the state's Energy Resources Coordinator with following objective for the state:

"To insure a dependable, efficient and economical energy system capable of supporting Hawaii's needs while increasing the state's energy self sufficiency and energy security."

At the present time, Hawaii has neither an economical nor a reliable energy system and will not have one as long as the state is linked to petroleum coming out of the Middle East.

Dr. Yoshihara observed that twenty years have passed since the OPEC oil embargo and little progress has been made nationally towards reducing our vulnerability toward the source of our principle energy form. "Desert Storm has taught us how important that energy supply is to our national and environmental security."

He noted that Hawaii's energy and environmental problems are of a magnitude much worse than the rest of the country. Yearly we see a plethora of legislative bills indicating the legislature's interest in helping to solve this problem. This past year, thanks to Representative Duke Bainum and Senator Matt Matsunaga, energy in Hawaii became a focal point with the convening of the *Energy and Environmental Summit.* This summit was a good forum for all sectors of local society to get together in order to discuss the issues and chart our course for the future.

The *Energy and Environmental Summit,* confirmed a deep and widespread interest in the subject of energy especially in the support for renewable energy systems and development in Hawaii. However, despite a strong commitment over the past 15 years and the number of legislative measures put into statutes to encourage development of renewable energies, Hawaii has still fallen far short of its original expectations. In reviewing those past expectations, Dr. Yoshihara outlined the following findings in a 1980 study conducted by Lawrence Berkeley Laboratory for DBEDT to forecast the future of renewable energy in Hawaii.

- By 1995, oil prices would range from $47 to $129 a barrel. *The current price for a barrel of oil is $15.00.*
- By 1995, an underwater submarine cable would be in operation bringing geothermal energy from the Big Island to Oahu. *No cable exists nor are there any plans for one.*
- By 1995, there would be no need for large oil-fired plants on the island of Oahu except to be held in reserve.
- By 2005, 432 MW of wind power would be generated on Oahu. *Currently 11 MW of wind power is operational.*

Dr. Yoshihara next posed the question, "Why has Hawaii fallen so short of the mark?" Acknowledging that oil prices have not risen nearly as much as predicted as part of the reason, he pointed out that there were other factors as well. Recalling a quote from the past, he drew a strong correlation to emphasize the high cost of research and development.

"Things we don't understand, prove more difficult than we believe," he quoted.

"New technology always costs more and takes longer to mature than we anticipate," he said siting some personal examples of this ranging from fixing a leaky faucet to hanging wallpaper and learning how to swing a golf club.

Drawing a disposable razor out of his shirt pocket, Dr. Yoshihara made a further analogy of this concept.

"This gadget," he said, " is a Gillette Sensor Razor with a simple objective to provide you with a close, smooth shave. Simple, but it cost $200M in research and development to produce. It is very high tech!"

Today's society is complex and demanding. It demands perfection as accurate as a computer and as reliable as the motor on your refrigerator or the Seiko watch on your wrist. The Gillette razor story demonstrates how costly it is to achieve this level of perfection in our society, he said.

In the 1980's, the building of wind machines seemed to be a simpler process than it actually was. It took a generation of windmills to prove that wind machines, if they were to meet modern requirements, would be more difficult to build than initially thought.

"In the end, the wind industry realized, it had not paid the price to provide the performance required," he said. "What if Gillette had released its product after only spending $50M instead of $200M?"

"The wind industry has finally paid the price and windpower has finally come of age and I don't believe that we have to wait another 15 years to confirm this. DBEDT is bullish on wind power and its application to Hawaii. " he said.

With some of the finest wind resources in the country, the high cost of electricity and the state's vulnerability to fossil fuels, DBEDT strongly supports wind power and remains committed to its success in Hawaii.

"We have 11 years to go to fulfill the prediction made in 1980 to have 432 MW of wind power on-line by the year 2005. Let's not bet against this possibility," Dr. Yoshihara said in closing.

Andrew Trenka, PICHTR

Mr. Trenka thanked Dr. Yoshihara for his keynote speech and offered these reflections of Hawaii and wind energy.

"Hawaii has been in the business of renewable energy, supportive of renewable energy and in the forefront of the development of renewables since the late 1970's and the early 1980's. Many of you saw some of the results of that leadership when you visited the wind farm in Kahuku this morning."

Hawaii recognized its dependence on fossil fuels early on and set forth specific goals and attempted to implement legislative as well as regulatory actions to achieve the implementation of renewables in Hawaii. Reiterating what Tak Yoshihara said, Mr. Trenka noted that Hawaii is still nowhere close to the objectives it set forth in 1980.

"We can all get together now as we did in a similar workshop organized and conducted by HNEI in 1985 and identify solutions and approaches to the problem and

realize no significant progress. We must focus on solutions that are implementable and set a clear path for implementation," said Mr. Trenka.

In summarizing the advances made in field of wind energy, Mr. Trenka cited some recent national statistics.

- More than 1500 MW of wind power are currently on-line in California.
- More than 3 billion kW/hr of power are generated in the United States by wind power on-line
- In other states, programs to integrate wind power are being implemented:
  1500 MW of wind power are being solicited in California
  300 MW in New York State, and
  100 MW in Minnesota (now increased to 425 MW).

Worldwide there has been a resurgence of interest in wind energy. The European community instituted a program for putting 4,000 MW of wind power on-line by the year 2000, a very ambitious goal. With some of the best wind resources available, Hawaii ought to be participating in some way.

- Capital costs are down from $3,000 to $950 per kW installed and some manufacturers say they can do it for less.
- O&M costs are down to 1¢ per kW/hr.
- Reliability is up to 85% to 95% or greater.
- A 50 MW wind farm can be developed, designed and implemented in 18 months or less according to some wind industry experts.

For those of us in Hawaii looking to implement the integration of wind energy, this is an encouraging message. Throughout the mainland, innovative legislative and utility actions and power purchase incentives are being targeted ranging from the concepts of green pricing, pilot wind projects funded by the state and standard power purchase contracts.

After providing a brief litany of some of the topics to be discussed over the next day and a half, Mr. Trenka introduced the first session presenter, Warren Bollmeier to lead off with the *History of Windpower in Hawaii.* Mr. Bollmeier has been involved in wind energy since 1977 on the Small Wind Systems Program at Rocky Flats, Colorado during the early days of the federal wind program. He is an active participant in the field having been awarded the AWEA award for "maintaining a strong and active working relationship with the wind industry" in 1986.

1.2 History of Wind Power in Hawaii—Warren Bollmeier, PICHTR

Early Uses of Wind Power in Hawaii. Early uses of wind power in Hawaii include the discovery and the settling first by Polynesians in sailing canoes and later by Europeans in the larger square-riggers. Water-pumpers were used on most islands from around the turn of the century. But most of these early turbines disappeared with the advent of the utilities.

Renaissance of Wind Power in Hawaii. In 1973, the nation learned that the low-cost, supply of oil could not be guaranteed, and this led to the investigation of the potential energy contributions from renewables. It led to a renaissance of wind power across the U. S. and especially in Hawaii.

There were several key players that contributed to the renaissance in Hawaii:

1) the state, which was among the early leaders in recognizing and valuing renewables;

2) government, both federal and state, which supported early research and development (R&D) and market conditioning activities in wind (these activities are discussed in *Panel 5: Government Support to Industry);*

3) the utilities, which supported the R&D activities, such as HECO's participation in the MOD-OA program with DOE, MECO's purchase of a Windane wind turbine and participation in the Zond/Wind-Diesel project with DBEDT, HELCO's integration of three wind farms on the Big Island, and, most importantly, Hawaiian Electric Industries' (HEI's) formation of Hawaiian Electric Renewable Systems (HERS) to become the first U.S. utility to own and operate a wind farm;

4) the University of Hawaii, which became heavily involved in wind resource assessment and R&D and public awareness activities; and

5) the wind industry, which moved out to set the stage for commercial activities in Hawaii.

Commercial Activities in Hawaii. For the workshop, PICHTR prepared a summary chart (Table 1.2) of the five major wind farms in Hawaii, which include three on the Big Island: Kahua Ranch, Lalamilo Wells, and Kamaoa and two on Oahu: Makani Moa'e and Makani Ho'Olapa. The first, Kahua Ranch, was installed in 1983, the last, Kamaoa in 1988. It is important to note that all of the wind turbines were first or second generation prototypes, with the exception of the MOD-5B, and the size of the wind turbines ranged from relatively small (Jacobs) to the world's largest wind turbine–the MOD-5B.

All of these wind turbines experienced design and operation problems, like others in California and at other locations. It is also important to note that the wind farms in Hawaii are small in capacity at less than 10 MW, compared to the wind farms on the mainland which are typically 25 to 50 MW or more (the total of the five wind farms in Hawaii is 27 MW). In general, the wind resource in Hawaii is stronger than most sites on the mainland, e.g., the wind site at Kahua Ranch is one of the best in the world.

Throughout 1992, the Hawaii wind farms have saved approximately 450,000 barrels of oil and approximately $9.0M.

Lessons Learned. The lessons learned, from a technical standpoint, can be broken down into two general areas–siting and wind turbine design and performance. Two important lessons were learned in siting:

1) the single-tower wind measurements, while representative of industry practice at the time, did **not** provide adequate data for the siting of the wind turbines–this generally led to overprediction of available wind speeds and energy outputs; and

2) the spacing in some of the wind farm arrays was too tight, resulting in reduced power outputs and higher-than-anticipated turbine dynamic loads. The latter tended to exacerbate wind turbine design problems. The good news is that industry has developed micrositing and analysis techniques which have solved the early siting problems and reduced the risk in estimating wind farm outputs.

There were two important lessons learned in wind turbine design and performance:

1) the wind turbines are representative of older technology, some of the wind turbines did not perform to their predicted power curves, most had higher-than-predicted operations and maintenance (O&M) costs, and some experienced power quality problems. The net results were losses in revenues; and

2) atmospheric and environmental conditions in Hawaii tended to exacerbate the wind turbine design process–specifically the ambient levels of turbulence were higher than anticipated and there were some component failures due to salt corrosion at some sites. The good news is that there have been major advances in wind turbine design which have resulted in dramatic improvements in performance and reliability and there have also been significant reductions in wind turbine and wind farm costs. The wind industry has maintained its interest in Hawaii by continuing to operate and improve the output of their wind farms and are seeking to enhance wind power's contribution to Hawaii's electric power supply. The industry is also seeking to meet growing market needs in the Asia-Pacific.

The Future Potential for Wind power in Hawaii. The performance of wind turbines has improved dramatically and costs have dropped significantly, the future potential in Hawaii would appear to be bright. The question put to workshop participants was: why is it that we aren't putting up more turbines in Hawaii? Most would agree that the answer is not a simple "we have got to do this or we have got to do that," in fact, that is one of the reasons everyone was at the workshop. Furthermore, the workshop was organized to address all of the key issues impacting further wind power development in Hawaii. Despite all of the potential reasons or issues impacting the development, there is one very compelling argument for further development–the wind resource in Hawaii is so great, we ought to be able to find a way to use it more effectively.

Wind farm	Kahua Ranch	Lalamilo Wells	Makani Moa'e	Makani Ho'olapa	Kamaoa
Owner/Operator	Kahua Ranch Limited	Lalamilo Ventures	Makani Uwila	Makani Uwila	Kamaoa Partners
Location	Kahua Ranch Island of Hawaii	Puako Island of Hawaii	Kahuku Point Island of Oahu	Kahuku Point Island of Oahu	South Point Island of Hawaii
Terrain	Mountain pass	Basically flat	Complex	Complex	Moderately complex
Wind speed	9.0 m/s (20 mph)	7.6 m/s (17 mph)	8.1 m/s (18 mph)	8.1 m/s (18 mph)	7.7 m/s (17 mph)
Installed Capacity	3.4 MW (2 phases)	2.3 MW	9 MW	3.2 MW	9.25 MW
Installed Cost	Not Available	Not Available	$25M	$15M	$11.7M
Operational Dates	1983 to Present	1985 to Present	1985 to Present	1987 to Present	1988 to Present
Turbines (Number)	Jacobs (198) Phase 1-17.5 kW (18) Phase 2-17.5 kW (180)	Jacobs (122) 17.5 kW (39) 20 kW (83)	Westinghouse 600 kW (15)	MOD-5B 3.2 MW (1)	Mitsubishi 250 kW (37)
Rotor Diameter	8.0 m (26')	8.0 m (26'):17.5 kW 8.6 m (29'):20 kW	43.3 m (142')	97.6 m (320')	21.9 m (72')
Current Capacity	300 kW (18 turbines)	1.7 MW (90 turbines)	7.8 MW (13 turbines)	3.2 MW	9.25 MW (37 turbines)
Capacity Factor	Not Available	Not Available	25%	20 to 22%	Not Available

Table 1.2 Hawaii Wind Farms (Commercial Projects)

2.0 Technology and Resource Status

2.1 Panel 1: Technology and Industry

Panel Chair

Sue Hock – National Renewable Energy Laboratory (NREL), Golden, Colorado.

Panel Members

Eric Miller – Kenetech Windpower
Robert Lynette – R. Lynette and Associates
Jeff Maurer – The New World Power Company
Edan Harel – TRM Advanced Wind Technologies, Ltd.
Robert H. Gates – Zond Systems, Inc.

Goals

The goals of this panel were to review the track record of the U.S. wind industry, including current industry structure and status, wind farm/turbine performance and costs, and suitability for application in Hawaii's market.

Summary

Wind Technology and Industry Growth. Wind technology, and the industry supporting it, have improved and grown dramatically over the past 10 to 15 years since the first wind farms were developed in California. The performance of wind turbines, measured in terms of energy captured and capacity factor, has improved dramatically. The cost of wind energy has dropped steadily during the 1980's and is now approaching 5 cents/kWh for some sites. At 5 cents/kWh, wind energy is considered competitive with fossil fuels for electric utility power generation. The overwhelming consensus of the panel was that wind turbine technology is here and now, it is ready for Hawaii and will be one of the cheapest sources for new electric power generation in Hawaii.

Future Projections. As the industry continues to mature, wind turbine designs are expected to improve further. With continued government assistance and the anticipated entrance of larger U.S. companies into the wind energy arena, the costs are expected to drop even further, perhaps to as low as 3.5 cents/kWh for some sites by the end of the decade.

Need for Government Support. There appears to be a growing consensus that the industry does not need the direct subsidies (i.e., tax credits) that fueled the initial development of the wind farms in California. At least one industry representative at the workshop stated that wind energy is "fully competitive with fossil fuels," as was the case in the recent competitive bidding process in California. However, in Hawaii, where construction and land costs and smaller wind farm or system capacities increase costs, some government incentives may be warranted. In addition, there is a need for continued government support in RD&D and market conditioning activities to reduce the risk of the introduction of wind technology in the utility marketplace throughout the U.S. and especially in Hawaii.

Recommendations

RD&D Support. Government support to the development of advanced wind turbine designs is viewed as a key factor to the further reduction of turbine costs and resolving other RD&D issues, such as utility interface issues, avian mortality and visual impact.

Market Conditioning Activities. Continued government assistance is needed to reduce the perceived barriers to the market. Raising public awareness is seen as one of the key roles that both the state, local and federal governments can play. Specific objectives would be to promote the environmental, economic and energy security benefits that wind power can offer. In addition, industry representatives felt that government can help by promoting appropriate consideration of wind power within the utility IRP/regulatory and legislative processes.

2.2 Panel 2: Resource Availability

Panel Chair

Karen Conover – R. Lynette & Associates, Redmond, Washington

Panel Members

Dick Cameron – Alexander & Baldwin, Hawaii Commercial & Sugar
Monty Richards – Kahua Ranch Limited
Mason Young – State of Hawaii Department of Land and Natural Resources

Goals

The goals of this panel were to provide information from a Hawaii State funded wind resource assessment, identify interested landowners and discuss land-availability issues.

Summary

Past Wind Resource Assessments. The State of Hawaii Department of Business, Economic Development and Tourism (DBEDT) with contracted support by R. Lynette & Associates (RLA) has performed an evaluation of Hawaii's Renewable Energy Resource Assessments (Ref. 1) as a precursor activity to the Hawaii Energy Strategy (HES). The results included an evaluation of potential wind sites based on wind data collected through state and federally-funded projects with the University of Hawaii (Meteorology Department), the Hawaii Natural Energy Institute (HNEI) and others. High potential sites were identified after screening based on land ownership, planned or competing uses, proximity to utility infrastructure, etc., for each of the major Hawaiian Islands.

Current Wind Resource Assessment Activity. Based on the results of the RLA study, DBEDT has funded additional work with RLA to install, operate and analyze the data from wind monitoring stations for one year at eight sites: two on Kauai, two on Oahu, two on Maui and two on the island of Hawaii. Karen illustrated with a series of maps the relative locations for land ownership and zoning for each of sites.

Potential Project Sizes and Characteristics. Karen discussed potential project sites on each of the inhabited islands (except Niihau). It is clear that the land is suitable for a number of projects in the 5 to 50 MW range. Most of the land is owned by either the state or private parties. Most of the land is currently zoned agriculture.

Landowner Issues and Concerns. A number of concerns and issues have been raised by landowners regarding the use of wind power in Hawaii. However, the primary concerns were visual impact, competing or conflicting land uses, potential difficulties in permitting projects, and overall public acceptance of wind power.

Recommendations

Joint Venture and Teaming. During this panel discussion, there was a strong consensus that everyone must work together as a team (or joint venture) to develop the wind power potential for the good of Hawaii. The team should consist of the landowner, utility, government, environmental groups, the manufacturer/developer of the wind technology and the public in general. It was felt that key issues could be identified, addressed and resolved through the early and committed involvement of each of the team members

Public Awareness. Again, as in panel 1, the consensus was that the public must be made aware of the benefits of wind power in general and merits of specific projects at an early stage. By public, the consensus is that it is not sufficient to include environmental, cultural or local-action groups, but also all non-affiliated individuals who wish to participate in the process.

State Agency Coordination. There was renewed support from the panel for an objective that the state has recognized for some time, i.e., that the permitting agencies could coordinate better to facilitate the permitting process. By facilitate, the consensus was that the process could be streamlined and shortened without short-circuiting the public's right to participate.

References

1) *Comprehensive Review and Evaluation of Hawaii's Renewable Energy Resource Assessments,* DBEDT, prepared by R. Lynette and Associates, Redmond, WA, April 27, 1992.

2) *Small System Performance Under High Wind Plant Penetration,* Research Project 2790-04, EPRI, Palo Alto, CA, prepared by Electrotek Concepts, Inc., Knoxville, TN March 1993.

2.3 Panel 3: Utility Integration Issues

Panel Chair

Charlie Smith – Electrotek Concepts, Inc., Arlington, Virginia.

Panel Members

Hamish Wong – Hawaiian Electric Company
Ed DeMeo – Electric Power Research Institute
Jonathan Lynch – Northern Power Systems

Goals

The goals of this panel were to discuss utility integration issues with an emphasis on the results of a study conducted by EPRI and Hawaii Electric Light Company (HELCO). The issues include power quality, operational characteristics, system reliability, system stability, load match, need for storage, and penetration levels.

Summary

Shortcomings of Conventional Technology Experience on the island of Hawaii. Charlie Smith reviewed the utility system voltage and frequency regulation problems encountered with DC machines with inverters and induction machines. These problems were magnified in Hawaii due to a weak, isolated system (i.e., non-grid intertied) with poor frequency regulation. He also discussed some bulk wind farm output data from Tehachapi and Hawaii. For example, these indicate that the power fluctuations are reduced as a function of 1/N where N is the number of wind turbines in the array and the reduction is based on the fluctuations from **one** wind turbine.

Recent EPRI/HELCO Study on Small System Performance. This study (Ref. 2) included analysis of six utility operational scenarios and considered the impacts of various events with and without the presence of wind turbines (both conventional and advanced designs) on the system. Mr. Smith noted that operation of the existing utility system presents a significant challenge and experiences significant problems. Conventional wind turbines only aggravate the situation. Advanced wind turbines, with variable-speed, constant-frequency output, present no problems to the operating system, and offer some potential benefits, through the capability of limiting outputs during increasing wind conditions.

Recommendations

Wind Technology. It was suggested that wind technology has advanced to the point where the wind turbines should not present operational problems to the utility. However, as the penetration of wind power increases on the utility system, overall power system planning is paramount.

Utility System Planning. Mr. Smith suggested that the key factor limiting the size of a wind farm is the size of the largest conventional unit on the island. Specifically, with the current generation mix, there is insufficient spinning reserve available during peak periods to cover the loss of the largest unit. He suggested that advanced wind turbines could also help the situation by "participating in spinning reserve."

Advanced wind turbines, either in isolation or as part of an automatic generation control (AGC) strategy with spinning reserve, offer the opportunity for increased amounts of wind generation and improved system operation.

Specific Topics for Consideration. From the overall utility operational perspective, it was recommended that: a spinning reserve policy be adopted, an AGC system be implemented, and benefits of storage, with or without renewables, be examined. With respect to increasing wind penetration, advanced wind turbines should be evaluated for any future installations.

3.0 Project Development and Implementation Issues

3.1 Panel 4: Project Development

Panel Chair

Jan Hamrin – Hansen, McQuat, Hamrin & Rohde, San Francisco, California

Panel Members

Dan Ching – HECO
Curt Maloy – New World Power
Keith Avery – Zond Systems

Goals

The goals of this panel were to discuss utility planning, alternative acquisition methods, resource contracting, alternative ownership arrangements and permitting issues.

Summary

The New Utility Paradigm. The utility business in the U.S. and around the world is changing rapidly due to a number of factors including: greater emphasis on the environment, greater concern over future risks (changing fuel costs, environmental regulation, utility structure), addressing consumer needs, greater use of market forces, and more emphasis on energy services. The movement is towards greater flexibility in contracting and investments and hedging strategies.

Acquisition Methods. Methods depend on the type of program, i.e., start-up, RD&D or basic resource acquisition, and the perception and management of the risks involved. The key risks are forecasting, environmental (including environmental regulation), economic (fuel-based versus resource-based) and technological.

Alternative Ownership Arrangements. Traditional utility ownership arrangements provide certain benefits to the shareholders, but there are risks which the utility assumes initially. These risks, however, are ultimately borne by the rate payers. In contrast, non-utility ownership arrangements transfer most of the risks to the developer, but remove benefits to the shareholder. Until recently, most wind projects have been developed under non-utility arrangements. But as utilities now weigh ownership decisions, there are also several "hybrid" arrangements that might be considered. For example, the risks can be shared as in the typical "turnkey" project, also referred to as the build-own-transfer (BOT). The utility can gain experience with new technologies at lower technology and cost risks, while obtaining shareholder benefits. Of course, once the utility accepts

ownership, it bears the performance risk. A second option is the build-own-operate and transfer (BOOT), which is similar to the BOT but includes a transition or operation phase during which the developer assumes the initial O&M risk. However, it has the disadvantage of being more complex from a contractual standpoint.

Resource Contracting. There are several important issues to resolve during contract negotiations: financiability, pricing certainty, interconnection requirements, contract sanctity, curtailment and dispatchability issues, as-delivered capacity and length of the contract term. The use of standard contracts with standard terms and conditions are valuable in facilitating the negotiation process. Specifically, the standard contract can simplify negotiations, reduce uncertainty, create equity among the participants and speed the process.

Permitting Issues. Proposed wind projects in Hawaii have generally been for land zoned as agricultural or conservation. Use of agricultural land for wind projects has been authorized based on an application for a variance to 30' height restrictions in the current zoning laws. The request is subject to a public hearing and approval by appropriate state or county agencies. Use of conservation land is more involved and is initiated with a Conservation District Use Application (CDUA) requiring an environmental assessment, and, if necessary, an environmental impact statement. The process is subject to a series of public hearings at the discretion of the approving agency.

Recommendations

Ownership Arrangements. Alternative ownership arrangements should be considered for future wind developments in Hawaii.

Wind Technology Improvements. In addition to further reduction in the costs of wind power in Hawaii, new wind technology must improve the quality of the wind power currently delivered to the utility and address issues of visual impact and avian mortality.

Cooperation and Confidence-Building. Industry and the utility need to cooperate and build confidence in the application of wind technology in Hawaii. For example, a wind energy collaborative could provide an important role by identifying and facilitating project opportunities that would benefit the rate payers, utility shareholders, landowners and power producers.

3.2 Panel 5: Government Support to Industry

Panel Co-Chairs

Ron Loose — *U.S. Department of Energy, Washington, D.C. (U.S. DOE)*
Maurice Kaya — *State of Hawaii Department of Business, Economic Development and Tourism (DBEDT)*

Panel Members

Lawrence Mott – Northern Power Systems
Mike Boughton – Maui Economic Development Board
David Rezachek - DBEDT

Goals

The goals of this panel were to share experiences from federal and state of Hawaii perspectives.

Summary

Government Leadership. Government's role is to sense and lead the public's interest, in this case, that wind (and other renewables) should play a greater role in the U.S. energy mix. Government must provide the leadership necessary to create a level playing field for renewables, including wind.

Federal Role. The federal wind program is working closely with industry to increase utility use of wind energy, develop advanced wind turbine designs, increase productivity and industry competitiveness and upgrade the applied research base. The first phase of the advanced wind turbine program, including market enhancements of seven existing designs, are to bring the cost of energy down to 5 cents/kWh in 5.8 m/s (13 mph) wind sites by 1995. The second phase, just initiated, will consist of innovative, next-generation designs targeted for 4 cents/kWh by the year 2000.

To stimulate greater utility confidence in wind technology, DOE, in partnership with EPRI, has implemented the wind turbine verification program. The first phase has resulted in two new utility-owned wind farms to be installed in 1995: one in Vermont with Green Mountain Power and one in Texas with Central South West. Proposals for the second phase have just been solicited. In parallel, DOE is now planning a commercialization initiative in response to the Global Climate Change Plan. The initiative will expand commercialization of wind through the creation of new alliances between the existing wind manufacturers and larger (Fortune 500) corporations.

The federal government will continue to play a key role leading a newly-announced collaborative that will provide a U.S.-wide forum for coordination of wind activities.

DOE's funding profile is increasing and will allow a major emphasis on the utility- and industry-coordinated programs, while maintaining a strong research base.

State Role. The perspective of DBEDT Energy Division is to stimulate commercialization of wind energy as an element of the Hawaii Energy Strategy (HES). The Energy Division's current activities fall into four areas:

1) maintenance of an accurate resource data base for use by industry and for input to the IRP process--jointly funded by DOE;

2) overcoming Hawaii-specific technical barriers to wind energy. DBEDT has partnered with DOE and industry to address specific grid integration and storage problems, support evaluation of design solutions for the Westinghouse wind turbines at Kahuku, and is considering *tropic-specific* wind turbine designs for Hawaii;

3) overcoming institutional barriers (specifically to advocate coordination and streamlining of the permitting process, making state land available for wind turbine development, and increasing public outreach activities); and

4) providing appropriate incentives (including tax credits that are in place, consideration of *adders* as part of IRP, and appropriate legislation).

Recommendations

Government Leadership. Government leadership is necessary, both at the federal and state levels, to provide financial support for stimulation of higher risk wind technology development and deployment. Government can also foster information transfer and coordination with the key stakeholders. The DOE has just initiated the formation of a U.S.-wide wind collaborative; the state should support the formation of a state wind collaborative.

Technology Barriers. The federal (DOE) wind program is highly focused to meet industry's needs to develop and commercialize new wind turbine designs, while maintaining a solid research base. The state should follow DOE's lead by coordinating closely with industry to identify and address Hawaii-specific technology needs, such as utility-integration issues and tropical-turbine designs.

Institutional Barriers. Specific suggestions were made to improve the education of the public (starting from elementary school children to adults and members of the legislature) and to streamline the permitting process (also panel 1).

3.3 Panel 6: Benefits of Wind Power to Hawaii

Panel Chair

Tom Gray – American Wind Energy Association (AWEA)

Panel Members

Richard Joun – DBEDT
John Mapes – Division of Consumer Advocacy, Department of Commerce
Paul Brewbaker – Bank of Hawaii

Goals

The goals of this panel were to discuss the benefits to Hawaii's economy, environmental and energy security costs, and macroeconomic impacts.

Summary

Economic. The primary economic benefits are increased employment, reduced supply risk (or expressed as an energy security cost), reduced price risk, reduced environmental regulation risk and improved trade balance. Several economic studies have been completed recently which tend to incorporate local impacts. One of these conducted by the state of California indicated that 27,000 employee-years were required to install the 1700 MW of wind turbines in California; and approximately 400 permanent jobs resulted. Another study performed by the Union of Concerned Scientists *(Powering the Midwest)* concluded that wind power development created more jobs per MW than individual conventional technologies and other renewables with the exception of some biomass options (when feedstock cultivation is taken into account).

Wind power development reduces supply risk by adding diversity to the fuel supply mix and some flexibility to responding to particular problems. For example, unpredictable swings in oil prices are avoided.

Environmental. The primary environmental benefits are reduced greenhouse gas emissions, reduced risks of oil spills, and reduced toxic air emissions. Some might argue that investment in wind power is like buying insurance on the risks of the future, not the least of which now is the risk of environmental regulation.[2]

Valuing the Benefits. While there is general agreement on the potential benefits of wind power, there is less agreement on how to value those benefits. Consequently, there

[2] For example, the administration's *Global Climate Change Action Plan* could result in legislation of significant environmental emissions. This would place a burden on the utilities to reduce current use of fossil fuels significantly.

is a lack of agreement on how to best value the benefits of wind power in the pricing and regulatory processes. AWEA has just commissioned a new study to take a fresh look at the economic and environmental benefits of wind power. This study, subcontracted to Nathan and Associates, will examine *generic* costs and benefits for the economic and environmental benefits of wind power within the framework of the IRP process.

Recommendations

Economic and Environmental Risks. While public sentiment favors actions to protect Hawaii's economy and environment, the rate payers have no protection (and hence bear the risks) from the consequences of the volatility in the oil supply and costs for environmental regulation. One option would be to shift those risks via regulatory action to the utility and its shareholders. This shift, which is viewed as a positive process, would then place the responsibility on utility management to select those options (both on supply and demand-side) which best provide insurance against those risks[3]. It should be noted, however, that the decision to implement this option is, in part, political.

Valuing the Benefits of Wind Power. In parallel to the AWEA study, it was recommended that a Hawaii-specific analysis of the economic and environmental benefits be conducted. Such a study would provide data and information for valuation of externalities which would benefit renewables and especially wind power in Hawaii.

[3] Editor's note: Dr. Janice Hamrin pointed out in panel 4 that the name of the game is risk management, not risk avoidance, in the new utility paradigm.

3.4 Panel 7: Integrated Resource Planning

Panel Chair

David Moskovitz –Regulatory Assistance Project

Panel Members

Roy Uemura – HECO
Blair Swezey – NREL
Colette Gomoto – PUC

Goals

The goals of this panel were to identify and discuss IRP challenges and opportunities and to share experiences of IRP activities from other utilities.

Summary

Integrated Resource Planning (IRP). IRP was spawned when utilities found it increasingly difficult, using traditional planning approaches, to predict demand and estimate costs of new generation and to incorporate demand-side management options. There was also concern regarding environmental risks. IRP has become a new tool, a new process, to make the increasingly difficult decisions among diverse generation and demand-side management alternatives.

Two recent policy initiatives by the federal government have supported the implementation of IRP. First, the Energy Policy Act of 1992 (which amended PURPA), listed renewables as alternatives to be evaluated as part of IRP, as well as a number of risk factors, including reliability, diversity, and dispatchability. Secondly, activity in response to the *Global Climate Change Action Plan* has recommended implementation of IRP at the state level. The state of Hawaii implemented IRP in 1990 in advance of the Energy Policy Act and has resulted in submittal of four IRPs to date. These plans, submitted by HECO, HELCO and MECO, are currently under review by the PUC. Once approved, each will be evaluated annually and updated every three years. Each has a 20-year planning horizon, with a 5-year action plan. The action plans include lists of planned resource acquisitions and demand-side-management initiatives. It was noted that while each of the four IRPs considers wind power as a commercial technology over the 20 year planning horizon, none of the four IRPs has included wind as part of their 5-year action plan.

The Potential For Renewables. Across the U.S., approximately 8% of the electricity is currently generated by renewables (primarily hydro); estimates for the potential contribution of renewables by 2030 are as high as 35 to 51%. Three key attributes of

renewables are sited as reasons for this rosy outlook: costs are dropping, system output and reliability are improving, and they can provide environmental and economic benefits. But the diversity of renewables complicates the IRP process.

The IRP Process. The IRP process provides a methodology for determining the worth (or value) of a resource. There are three important elements in establishing the *worth* of a resource: when will it be brought on line (timing), where will it go (location) and what are its key attributes (characteristics). Ideally, in IRP, once the resource values are established, those which *cost* less than they are *worth* will be selected. Hence, the more diverse the resource options, the more you need IRP and the more sophisticated the planning tools need to be.

Removing the Barriers. However, there are barriers which make it difficult to establish the worth of renewables, and especially wind, hence, cost-effective renewables may be overlooked. Some of these barriers relate to the resource-specific avoided cost, its distributed value, perceived reliability, risks and uncertainties in implementation and externalities. But there are no *magic* bullets to remove the barriers; the approach is part policy and judgment, and part analytic.

Risk Analysis. Risk analysis is an important tool, especially when two or more options appear to be equally attractive. However, the ultimate decision will be impacted by the specific risks (and the relative weighting that is applied) and from which perspective (utility or consumer) the risks are assessed. For example, the state of Maine reduced it's oil dependence from 40% to 5% over a 10 year period by utilizing renewables and energy efficiency. The objective was to hedge against oil price volatility. However, the utility rates increased by 35% over a 5 to 6 year period, which was a 4 to 12% higher increase than if conventional options had been employed. This was due, in part, to declining oil prices. The state of Maine, in fact, has paid a premium, for the reduction of its oil dependency. Was it a reasonable price to pay? While utility rates have increased, the state is currently avoiding $200M/year in oil purchases and environmental emissions.

Recommendations

Improving IRP. As a result of this panel discussion, it is clear that additional exchange of information and experience with the IRP process will be constructive. However, in order to better evaluate renewables, local (site-specific) information on resource strength and construction costs must be taken into account.

Valuing the Attributes of Wind Power. The attributes of wind power, as well as most renewables, are very site-specific. Additional data and information are needed to characterize the statistical contributions to capacity provided by wind. Within IRP, the valuation of capacity and other attributes of wind should then be compared with its cost.

4.0 Stakeholder Perspectives

4.1 Opening Comments

Presenter

Ron Lehr – Consultant

Panel Members

Tom Jezierny – Maui Electric Company (MECO)
Warren Lee – Hawaii Electric Light Company (HELCO)

Goals

The goals of this introductory session were to provide an overview of approaches to facilitate the proactive involvement of key stakeholders to enhance the use of wind power in the electric utility.

Summary

Who Are the Stakeholders? The definition of stakeholders is very broad, but generally includes anyone who is interested in a particular issue, e.g., meeting the electrical energy needs of the people of the state of Hawaii. The list of stakeholders includes the utility, the vendors or suppliers of energy technology (i.e., industry), the government (both legislative and executive), the utility regulators, the landowners, environmental or consumer advocacy groups, independent research organizations such as the university or PICHTR, the consumers and the public in general. Given the list of stakeholders, some will be key, i.e., without their support you do not move ahead, they hold decision power, make financial decisions and hold veto power. In this case, the key stakeholders (subject to some disagreement) are the utility, industry, the PUC, the landowners and consumers. Supporting stakeholders are those which have affected interests, can facilitate the key stakeholders, have a strong claimed interest and provide helpful, supportive roles. These would be government, research organizations, environmentalists.

What is the Process of Involving the Stakeholders? The formal legal due process employed by most Public Utility Commissions has five elements:

1) notice,

2) a hearing,

3) a fair decision-maker,

4) a record of the decision, and

5) appeal.

The process can be much more informal and still be fair to all concerned. Interested parties make themselves known or are identified by the key stakeholders. The informal process can consist of procedures to reach agreements with less cost and more effectiveness than formal legal due process. Informal procedures can be applied to the challenges of identifying, evaluating and selecting energy options for the electric utility. By working through information gathering, consensus building and negotiation, and finally, litigation when negotiations are unsuccessful, utility planners can reach conclusions about how to supply needed resources.

Why Commercialize Renewables? There are several key attributes of renewables that make them attractive to utilities:

1) environmental concerns: renewables generally offer attractive environmental benefits;

2) the costs and risks associated with fossil fuels—renewables can provide a hedge against fuel price volatility and reduce energy supply risks;

3) the productivity of new technology—costs of renewables are coming down, performance and reliability is going up, their diversity and modularity can offer utility integration advantages;

4) customer preferences—again renewables offer attractive alternatives; and

5) the utility competitive advantage—in many cases, utility-ownership arrangements will be the best for the utility and the rate payer.

Elements of a Successful Commercialization Strategy. There are many elements of a potentially successful commercialization strategy, but the most important are a shared vision of the future, a willingness to enter into partnering relationships and leadership based on a common agenda.

The Utility Perspective in Hawaii. The utilities in Hawaii are undertaking integrated resource plan (IRP) processes on each of the islands. IRP is viewed as the means to meet the goals of proactively involving key stakeholders to enhance the use of wind power in the electric utility. Stakeholders can become involved through intervention (the technical term for formal involvement in the IRP docket), membership on IRP Advisory Groups (a more informal forum), public meetings, etc. The current IRP elements include forecasting consumer demand, evaluation of demand-side management and supply-side options and an integration of the preferred options to meet the demand over a twenty year planning horizon. Within the IRP framework, the utility seeks to provide reliable, high-quality power to its customers at the lowest reasonable cost. Public concerns such as environmental impacts are to be addressed in the process. While it is believed that wind power has many positive attributes, the utility is still accountable for the quality and reliability of the power delivered to the customer. There are concerns, based on the utility's experience with wind power, regarding the quality and reliability of wind power. It is also recognized that the IRP provides a forum for exchange of information on the improvements in wind technology.

Recommendations

This panel discussion focused on how stakeholders, in general, might be involved, with some emphasis on the current IRP process in Hawaii. The discussion did not result in any specific recommendations. See sections 4.2 to 4.4 for additional discussion on stakeholder perspectives.

4.2 Panel 8: Public Perspectives

Panel Chair

Clyde Murley – Natural Resources Defense Council, Berkeley, California

Panel Members

Ira Rohter – Green Party
Scott Derrickson – Hawaii Energy Coalition
Michael Jones – Union of Concerned Scientists

Goals

The goals of this panel were to discuss key issues pertaining to public acceptance of wind power in Hawaii: environmental benefits, alternative land uses, aesthetics, noise and avian habitat.

Summary

Clyde Murley asserted that the public is a key, if not the ultimate, stakeholder, but one whose involvement to date has often been limited or overlooked. The public generally favors the use of renewables, and especially wind, but mobilizing this general acceptance into an impetus for action represents a formidable challenge, both on a global and local scale.

Global Public Perspectives. IRP, as the new planning standard, is designed to include externalities and other public concerns. But there are significant hurdles that the public must overcome in order to achieve meaningful involvement:

1) institutional inertia *(business as usual),*
2) difficulty in quantifying or analyzing externalities, and
3) organization (the public is dispersed, unorganized and with multiple interests and lack of resources to support full involvement or intervention).

As a consequence, the process now tilts the playing field significantly in favor of private over public interests. Two key elements must be addressed:

1) the quantification or monetization of externalities–while most externalities may be quantifiable, those that resist quantification should not be ignored; and
2) a bias in cost accounting practices towards local, as opposed to global, and especially near-term as opposed to far-term impacts. These patterns of bias can skew decision making away from the public interest, which, in this case, is to use more wind power in meeting our electrical energy needs.

Local Public Perspectives. For wind power development to be successful in Hawaii, there are several local (or site-specific) public acceptance issues which must be addressed:

1) land-use (referring back to the panel 2 discussion, the use of the land for wind power must be compatible with other uses and land owner interests),
2) avian habitat (a wind power plant should be sited to avoid, and all steps taken to mitigate, bird collisions with the wind turbines or their towers),
3) visual impact and noise (siting of wind turbines should be viewed and discussed with the public within a broad context of weighing the positive environmental and economic benefits against perceived negative impacts).

Advancing the Public Interest. The following conditions are felt to be necessary for advancing the public interest:

1) funding to support public involvement—the cost of intervention in the IRP process is high;
2) technical and subject matter expertise;
3) extensive involvement in the decision-making process;
4) a collaborative process to build consensus; and
5) creative approaches to improve the IRP process.

An assessment of the status of IRP in Hawaii indicates that the public interest is severely *out competed* by the private interest, most externality concerns are elevated in rhetoric but are inconsequential in actual decision-making, institutional support for wind power is lagging behind the public impetus and IRP currently is **not** a solution but a framework whose potential has not been realized.

Public Assessment of Wind Power in Hawaii. Generally, wind power is substantially superior to fossil-fuel-derived power from a public perspective. The regulatory and legislative infrastructure is lagging behind the public interest in providing the necessary and appropriate impetus for accelerating wind development.

Recommendations

The IRP is viewed as a framework whose potential might be improved if:

1. funding could be provided for public participation in planning, policy development, regulatory and legislative processes;
2. establishment of legislative and PUC public advisors to serve as focal points for advancing public interests;
3. a stronger role was created for the public in the IRP advisory processes;

4. there was increased use of public/private collaborative processes;
5. a strong public education effort was supported; and
6. analytical methodologies **and** decision processes were redesigned to be accountable to the new standards in energy planning.

4.3 Panel 9: Regulatory Perspectives

Panel Chair

David Moskovitz – Regulatory Assistance Project

Panel Members

Ron Lehr – Attorney
Collette Gomoto – Public Utility Commission
Gerald Sumida – Attorney

Goals

The goals of this panel were to discuss regulatory perspectives in the U.S. and applicability to Hawaii.

Summary

The regulatory process does vary from commission to commission. The ones that are highly litigious are the least productive and tend to *pit* utilities against the developers. There are some good models out there; there are also some good initiatives for treatment of renewables, and especially wind, within the context of the IRP process.

Initiatives. The initiatives or regulatory techniques essentially are attempts to improve the calculation of avoided cost. They include:

1) green pricing—the rate payer pays a premium for an environmentally-preferred service, the utility is obligated to acquire new renewables--a number of pilot programs are underway, but the question (yet unanswered) is whether the rate payers are **actually** willing to pay for the green option;
2) supply-side incentives—such as production incentives and allowing the utility to make a *profit* on purchased power;
3) green RFPs—viewed as a good option to hedge against tightening environmental requirements and global warming concerns--the initial attempt by the North East Energy System resulted in more, cost-effective options than was predicted;

4) Renewable Set Aside—a portion of the IRP is devoted to renewables with a focus on demonstration and commercialization (but additive to renewables R&D)—benefits accrue to all stakeholders; and

5) Safe Harbor Rules—provides for utility desire for certainty and regulators' desire to avoid pre-approval of cost recovery and removal of risk from the utility manager. However, the utility remains cautious to safeguard its need for prudent management.

Regulatory Climate in Hawaii. The Hawaii Public Utilities Commission (PUC) has required the Hawaiian utilities to implement IRP (reference discussion in panel 7). The PUC is supportive of the use of renewables and the consideration of externalities within the framework of IRP, but has not prescribed any specific measures or initiatives, such as those discussed above. During the panel discussion, several points were raised regarding the implementation of IRP:

1) the role of independent power producers (IPPs) in IRP - The IRPs in Hawaii assume that the utility will acquire new generation. Hence, IPPs are not included in the actual IRPs unless a power purchase contract is in effect, such as the case with Applied Energy Services, HPOWER, the sugar companies and others. In some cases IPPs have participated during the advisory and review periods. Finally, it was noted that a market test (competitive bidding) has proven to be useful as a supplement to IRP supply-side screening in about 25 states; and

2) a more equitable treatment of risk in cost analysis for wind—the present practice is to use the *weighted average cost of capital* or WACC for the discount rate. The WACC includes elements of fuel risk, which are not appropriate for wind and other renewables. An alternative, such as the *risk adjusted discount rate,* (RADR) provides capital-specific treatments.

Recommendations

The PUC should consider and evaluate further:

1) alternative initiatives for encouraging renewables,

2) treatment of risk in cost analysis for wind versus other supply-side options,

3) role of IPPs in the IRP process, and

4) cooperative and collaborative activities.

4.4 Panel 10: Legislative Perspectives

Panel Chair

Eric Sikkema – National Conference of State Legislatures

Panel Members

Matt Matsunaga – Hawaii State Senate
Duke Bainum – Hawaii State House of Representatives
Robert Herkes – Hawaii State House of Representatives

Goals

The goals of this panel were to discuss legislative perspectives in the U.S. and applicability to Hawaii.

Summary

There is a growing interest in wind at state legislatures in recognition of the energy, economic and environmental benefits. Many utilities have taken the lead in implementing wind power. However, in several states the legislature has taken the lead. The focus and force of this involvement varies from state to state. Wind legislation is successful when the state has abundant resources, aggressive implementation policies, quality information on wind technology, economics and benefits, and the PUCs and utilities work together.

Initiatives. State legislative initiatives include:

1) general encouragement of wind energy development,
2) stated preference or policy for renewables (where wind is included in the definition),
3) tax incentives,
4) production tax credits,
5) financing options,
6) integrated resource planning,
7) consideration of externalities, and
8) set-asides (especially when the PUC supports it) and adders.

Recent Legislation. A number of states have passed or are considering new legislation that will support wind:

1) California—50% of new generation, for the three major California utilities, is to be renewables by the year A.D. 2000 with a 300 MW wind power set-aside (1991 law);

2) Iowa—an avoided cost was set at 6.0 cents/kWh for alternate power producers (1993 law);

3) Oklahoma—a three year residential tax credit of 40% (up to $2500) and 30% for commercial systems (up to $150,000). All installed systems have to be certified (1992 law);

4) Minnesota—a preference for renewables (utilities must show that non-renewables are not in the interest of the people of Minnesota) and a requirement of 425 MW of wind power installed by the year A.D. 2000;

5) Several states including Iowa, Kansas, North Dakota, South Dakota, Massachusetts and Wisconsin have passed various forms of income tax credits, property tax exemptions or sales tax exemptions.

State Energy Plans. At least 20 states have a state energy plan or strategy. The plans, which generally compliment existing legislation, provide guidance and state goals and objectives, and encourage collaboration among legislators, state energy offices, utilities and public utility commissions. The 1992 New York plan is viewed as a good model. It set a goal of 300 MW of new electricity capacity from renewables by 1998. Although the state has excess capacity, it will encourage utilities to develop wind for future demand. And, as noted in panel 5, the state of Hawaii is implementing the Hawaii Energy Strategy program which will produce an integrated energy strategy for the state.

Legislative Environment in Hawaii. State Senator Matt Matsunaga and State Representative Duke Bainum convened and led the *Energy and Environmental Summit* in October 1993. The overall goal of the summit was to gain *consensus* on key issues and, where appropriate, coordinate and draft legislation. Within the Energy Committee to the summit, there was strong consensus that further use of renewables for the generation of electricity should be encouraged. Consequently, a number of bills were drafted and discussed within the Supply-Side Subcommittee. Most of these bills were forwarded to the legislature. The majority were not passed from legislative committee, in part, due to the lack of support by the utilities and the PUC, but also due to the tight budget constraints of this year's state legislature[4].

[4] Editor's note: At the time of the workshop, legislative hearings were still underway, so that the comments in the text above reflect the status as of that time. It should be noted that one important resolution was passed. The resolution (SCR No. 40) requires the PUC to open a renewables information docket. It is hoped that this docket will facilitate the informal exchange of information on renewables and the PUC's consideration of regulatory alternatives to improve the IRP.

Recommendations

Several recommendations were made:

1) consideration of stronger legislation during next year's session,

2) working with the utilities and the PUC to aggressively implement IRP,

3) building of consensus through the summit process,

4) establish a State Energy Commission to facilitate overall planning and coordination of energy issues.

5.0 Wrap-Up Discussions and Comments

Synopsis of the Panel Discussions.

Each of the presenters was asked to provide a brief synopsis and highlights from their respective panel discussions.

Session 2: Technology and Resource Status

Panel 1 (Technology and Industry: Ms. Sue Hock). The industry is now or on the verge of producing the 5 ¢/kWh wind turbine. The 4 ¢/kWh advanced wind turbines are on the drawings boards and are expected to be in the marketplace by 2000. In Hawaii, while there have been problems, the industry's experience has been particularly valuable, as problems with turbulence-induced loads and salt-corrosion were identified and are being resolved. The industry has matured and is no longer viewed as a cottage industry of *granola crunchers*.

Panel 2 (Resource Availability: Ms. Karen Conover). Hawaii has an excellent wind resource on each of its islands. The resource is well-documented and on-going wind measurements are supported by the state. Potentially, there are excellent wind sites on both state and private land available for development. But there are concerns voiced by some potential landowners about the use of their land for wind power development. These include visual impact, competition with existing or planned uses, avian mortality, cultural and native Hawaiian concerns.

Panel 3 (Utility Integration Issues: Mr. Charles Smith). This panel discussed the details of a study conducted on the Big Island's utility system and operating characteristics and experience with wind power. The study identified the need for spinning reserve, frequency regulation and automatic generation control to improve utility operation. The new generation of advanced wind turbines are expected to overcome all of the disadvantages seen with the first generation designs on the island. The new turbines will be able to provide both real and reactive power, and possibly participate in frequency regulation. A joint utility/developer collaborative was proposed to investigate strategies for increasing wind power penetration on the island.

Session 3: Project Development and Implementation Issues

Panel 4 (Project Development: Mr. Keith Avery, substituting for Dr. Jan Hamrin). Project development of wind power has been difficult in Hawaii. The utility's role is changing, and there are new opportunities in how contracts are designed, how wind power is integrated and how projects are developed, owned and operated. With respect to projects to be developed by independent power producers (IPPs), two recommendations were made:

1) an incentive should be created to provide a benefit to the utility and its shareholders, and

2) additional discussion is needed on the contract elements required for a financiable project. The process of project development can be enhanced through cooperation and confidence building between industry and the utility, but public input and responses are also needed.

Panel 5 (Government Support to Industry: Messrs. Ron Loose and Maurice Kaya). At the federal level, the appropriate roles are technology development and support to the industry to expand commercialization. However, the form of the support is changing. Tax credits are becoming obsolete, as the economics of wind power improves, but there are still technical and cost risks associated with project development. The federal government is seeking to share that risk with local stakeholders. At the state level in Hawaii, the key roles are support of resource assessment, overcoming technical impediments to wind power application in Hawaii, removal of institutional barriers and application of appropriate incentives. The state can provide an additional role by facilitating the formation of partnerships with the federal government and industry. One lesson that has been learned is that the state needs to not only talk to but also listen to the other stakeholders as well.

Panel 6 (Benefits of Wind Power to Hawaii: Mr. Tom Gray). Wind power has public support and can provide certain economic and environmental benefits both at the local and global levels, e.g., increased employment, reduced supply risks, etc. However, many of the benefits of wind power are not readily quantifiable, and there is disagreement on the best approach to valuation of these benefits. Consequently, there is a need for educating the public on the benefits of wind power.

Panel 7 (Integrated Resource Planning: Mr. David Moskovitz). Integrated Resource Planning (IRP) is an effective tool for obtaining *least cost* energy services. The basic approach is to determine the worth or value of energy alternatives and select those with costs lower than their value. Avoided costs are typically taken as the value of power provided to the utility by an alternative energy source. Improvements in the IRP process are generally focused on improvements or refinements in the avoided cost. Other key issues in IRP are risk and uncertainty, fuel diversity, and capacity value. Arguments have been made that wind power can reduce risks and uncertainty in the energy supply, can contribute favorably to fuel diversity, and possesses a non-zero capacity value. Overall, IRP can provide an effective tool in supporting sound judgment in the utility planning process.

Session 4: Stakeholder Perspectives

Opening Comments (Messrs. Ron Lehr, Tom Jezierny and Warren Lee). Overall, too much time is spent on substance, rather than the process in IRP. The process can be improved by better identification and inclusion of stakeholders in advisory groups. Utilities, in general, are showing a willingness to consider wind power. The catalyst for a more meaningful process would be the formation of a wind energy collaborative, consisting of the utilities, regulators, industry, government and the public. The utility perspective includes prime consideration of the quality and cost of electrical service. The utility has been *burned* by its early experiences with wind power. While IRP has created some attractive incentives for introduction of new technologies (such as DSM), the utility's commitment is to avoid an increase in its costs to the rate payer. IRP is the chief mechanism for renewed examination of wind power. The utilities support a collaborative approach in the development of action plans and public participation in the advisory groups.

Panel 8 (Public Perspectives: Mr. Clyde Murley). The advancing of the public perspective is a mighty struggle. The public views wind power as a sensible energy choice. However, the exclusion of externalities in the IRP process now stands as a barrier to this public will. But there are significant institutional barriers against public participation, one of which is the political process in Hawaii itself. A specific concern voiced by the panel is the current bias in IRP towards quantification, i.e., if a perceived benefit cannot be quantified, then it will not be included or will be inconsequential in the decision process.

Panel 9 (Regulatory Perspectives: Mr. David Moskovitz). The regulatory process works best if done collaboratively through information exchange and negotiation, but sometimes litigation is required. A number of new initiatives have been considered to encourage renewables, including green pricing, green RFPs, utility incentives, production incentives and *risk-adjusted-rates* for evaluation of life cycle costs for renewables.

Panel 10 (Legislative Perspectives: Mr. Eric Sikkema). States can learn from each other. Legislation supporting wind power (and other renewables) has been more effective when supported by the regulators, utilities and consumer advocacy groups. In Hawaii, this year's legislative efforts fell short of the consensus achieved during the *Energy and Environmental Summit.* However, it was noted that it is very difficult to pass legislation in Hawaii on the first year's attempt, when it normally takes up to three years. Cooperative and aggressive action might result in success sooner than three years.

Discussion

Education. The need for education was acknowledged and stressed again. The need to educate the public extends all the way from school-age children to legislators. This is an area where the state can show leadership.

Externalities. Businesses are already involved, or need to be, in IRP. The point was made that externalities should be used in pricing, not just in planning. It was suggested that a value be *assigned* as a place holder until a specific assignment can be made.

Incentives. Utilities need an incentive to go for wind power. The question is whether the industry still needs incentives? Ron Loose indicated that DOE is not looking at long-term incentives. However, to encourage further commercialization, the initial risk of market penetration needs to be overcome. Consequently, the government *buy-down* of that risk is viewed as a temporary measure to get industry *over the hump.*

Good Experience. Ed DeMeo (EPRI) pointed out that Hawaii's major problem with wind has been its own bad experience. What is needed is a way to *engineer* a good experience (rather than replicate it). Deployment assistance (viz.-a-viz. the joint EPRI/DOE wind turbine verification program) is a good example of a way to work together to engineer that good experience.

Legislative Activity. Dr. Rezachek (DBEDT) indicated that, while some of the summit bills were still alive, help was needed from those present to provide testimony. A list of the bills, with their status, was included as part of the panel 8 discussion.

6.0 Conclusions and Recommendations

Conclusions

The Hawaii Windpower Workshop brought together approximately 80 key government, utility, industry and private representatives in Honolulu, Hawaii, to discuss and learn from each other how additional windpower might be added to the supply mix for the Hawaiian utilities. A key outcome of the workshop was the overwhelming consensus that the use of windpower should be increased in Hawaii. This consensus was consistent in all of the panel discussions, and throughout the entire workshop. Furthermore, it is significant the discussions were sometimes lively, but not heated; informative and accurate, but not biased; and proactive, but not reactionary.

In 1984 a similar workshop was held, at which time many of the same issues were raised, and a similar vision of the future of windpower was painted. Since then much has been learned about the applicability of windpower in Hawaii. This vision of the future of windpower in Hawaii has been reinforced and renewed because of the:

1. progress that industry has made in improving wind turbine performance and reliability and in lowering costs, e.g. installed costs have dropped from $3,000/kW to $950/kW; cost of energy has similarly dropped from over 20¢/kWh to 5¢/kWh;
2. willingness of the Hawaiian utilities to examine the technology integration issues and to take a *fresh* look at the benefits of windpower; and
3. implementation of IRP which is leading to the proactive inclusion of more stakeholders in the process of determining the energy future of Hawaii.

Despite the consensus on the objective of using more windpower, it is also recognized that not everyone agrees on its implementation. However, there was general agreement and a willingness on the part of the participants to continue the discussion. This willingness is the basis for the recommendations which follow.

Overall Recommendation

The overall recommendation is to form a Hawaii wind collaborative. The collaborative will be the vehicle for establishing and maintaining a cooperative and collaborative approach to enhancing the use of wind power to meet the electrical energy needs of the people of Hawaii. The suggested key participants for the wind collaborative in Hawaii include: the state (legislature, DBEDT, DLNR, and others), county and federal (DOE) governments; the utilities and the PUC, industry, landowners, environmental and consumer advocacy groups, and the public at large. PICHTR will spearhead the activity to form the collaborative within the next three months. The collaborative is viewed as an informal process which can contribute positively as an adjunct to IRP, which is viewed as the more *formal* process.

Specific Recommendations

The wind collaborative will be the ongoing forum for addressing windpower implementation issues, establishing common agendas and promoting windpower in Hawaii. From the workshop, the following were identified as key issues with recommended actions:

1. *Public Awareness:* Implement public awareness programs regarding the potential impacts (benefits and costs) to the communities in Hawaii due to wind power development. The potential impacts include economic and environmental benefits, and concerns regarding visual compatibility, avian habitat and mortality, compatibility with existing or planned uses, and social and cultural values;
2. *IRP:* Investigate appropriate mechanisms for evaluating wind power within the IRP framework, including ways to increase and enhance public involvement, and recognition of economic and environmental benefits, capacity value, and other benefits which might not be readily quantifiable;
3. *Regulatory Process:* Encourage information exchange and negotiation in the regulatory process. Consider specific initiatives to encourage wind power, such as production incentives, utility incentives for independent power production, green pricing and green solicitations;
4. *Wind Technology:* Support refinements in wind power technology to meet Hawaii's combination of turbulent, humid and salt-corrosive wind conditions with possibility of periodic hurricane force winds;
5. *Utility Integration:* Conduct detailed power system studies to investigate the feasibility of increased penetration of wind power on each of the island grids, including the potential for wind power and energy storage to participate in frequency regulation, peak-shaving and spinning reserve; and
6. *Project Development:* Facilitate formation of partnerships to develop specific wind power projects.